Manure Digesters – The New Rural Energy Engine

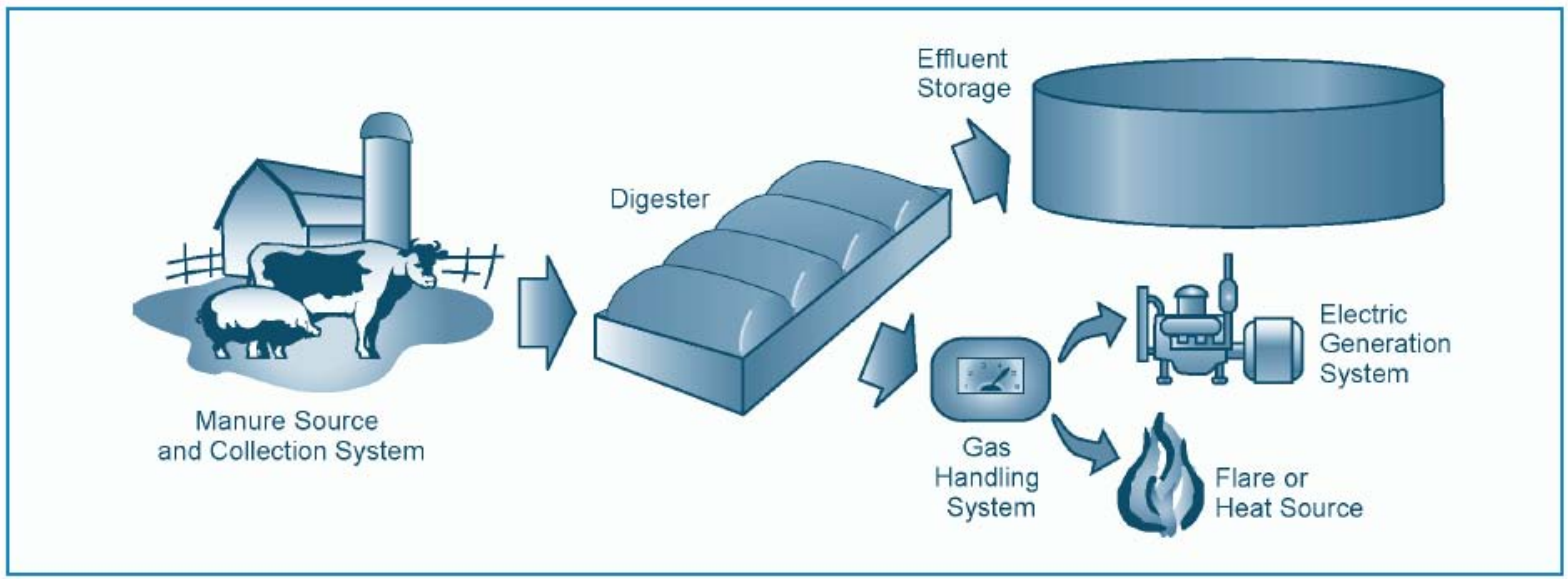
Chris Voell, Program Manager
EPA AgSTAR Program

My Background

- Worked in non-profit, private and public sectors
- 20+ years in solid waste management
- 10 years in methane capture and use
  - 8 years in landfill gas energy
  - 2 years in manure digesters
- 3 children

What are Anaerobic Digesters?

- Biological treatment systems for liquid and slurry manure, which collect and combust off-gases.
- Digesters separate manure treatment from storage functions.
- Anaerobic digestion is a biological process in the absence of oxygen.



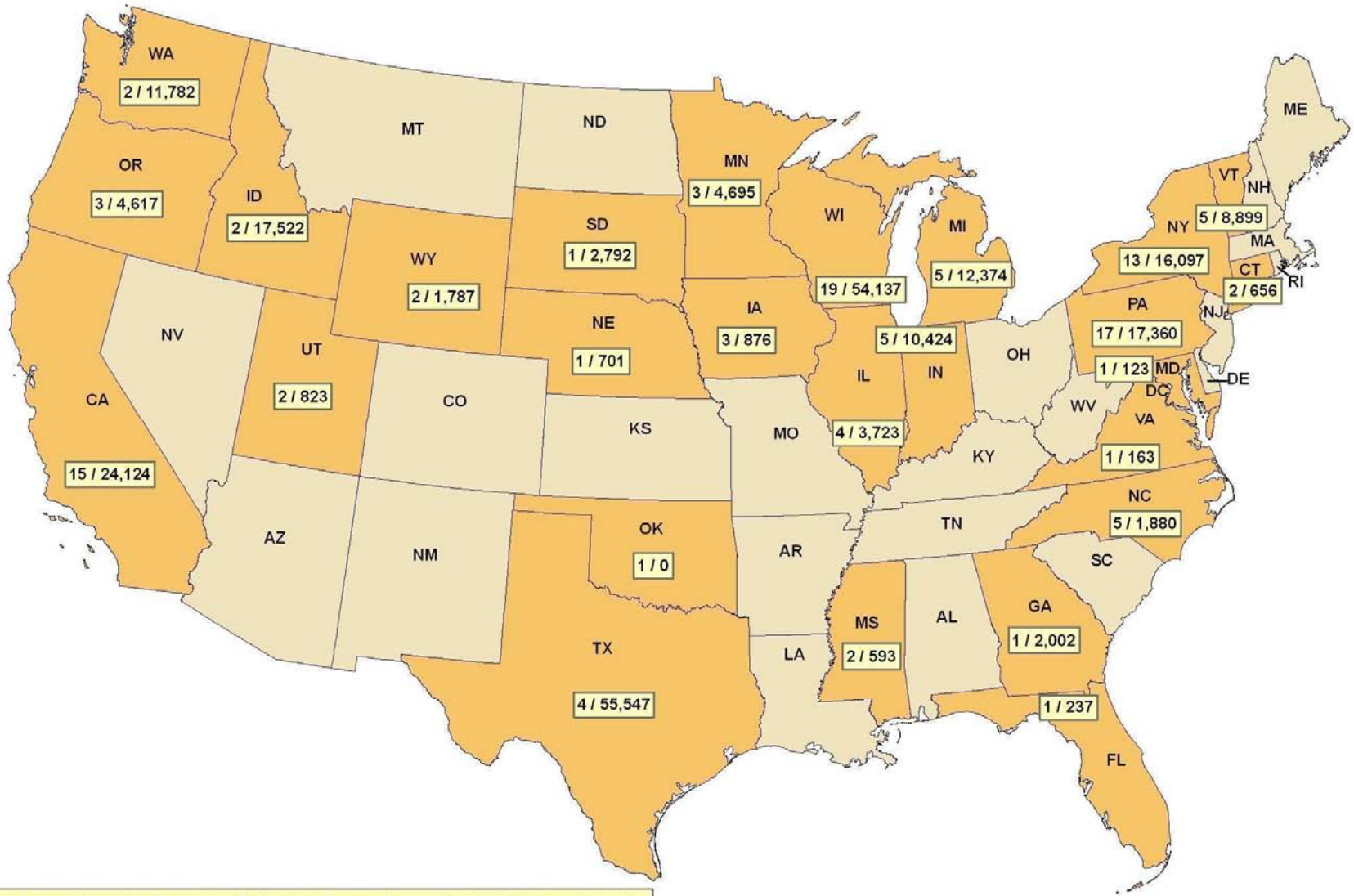
What can digesters do?

- Offer air quality benefits
  - Reduce greenhouse gases (methane)
  - Control odors from storage and field application
  - Controls other emissions (H_2S, VOCs)
- Offer water quality benefits
  - Stabilize manure organics (reduce biological and chemical oxygen demand)
  - Significantly reduce pathogens
- Financial Benefits
  - Only waste management system with potential for return on investment
    - Energy revenues
    - Carbon $
    - Nutrient value
    - Fiber (primarily dairy manure)

Digesters in United States

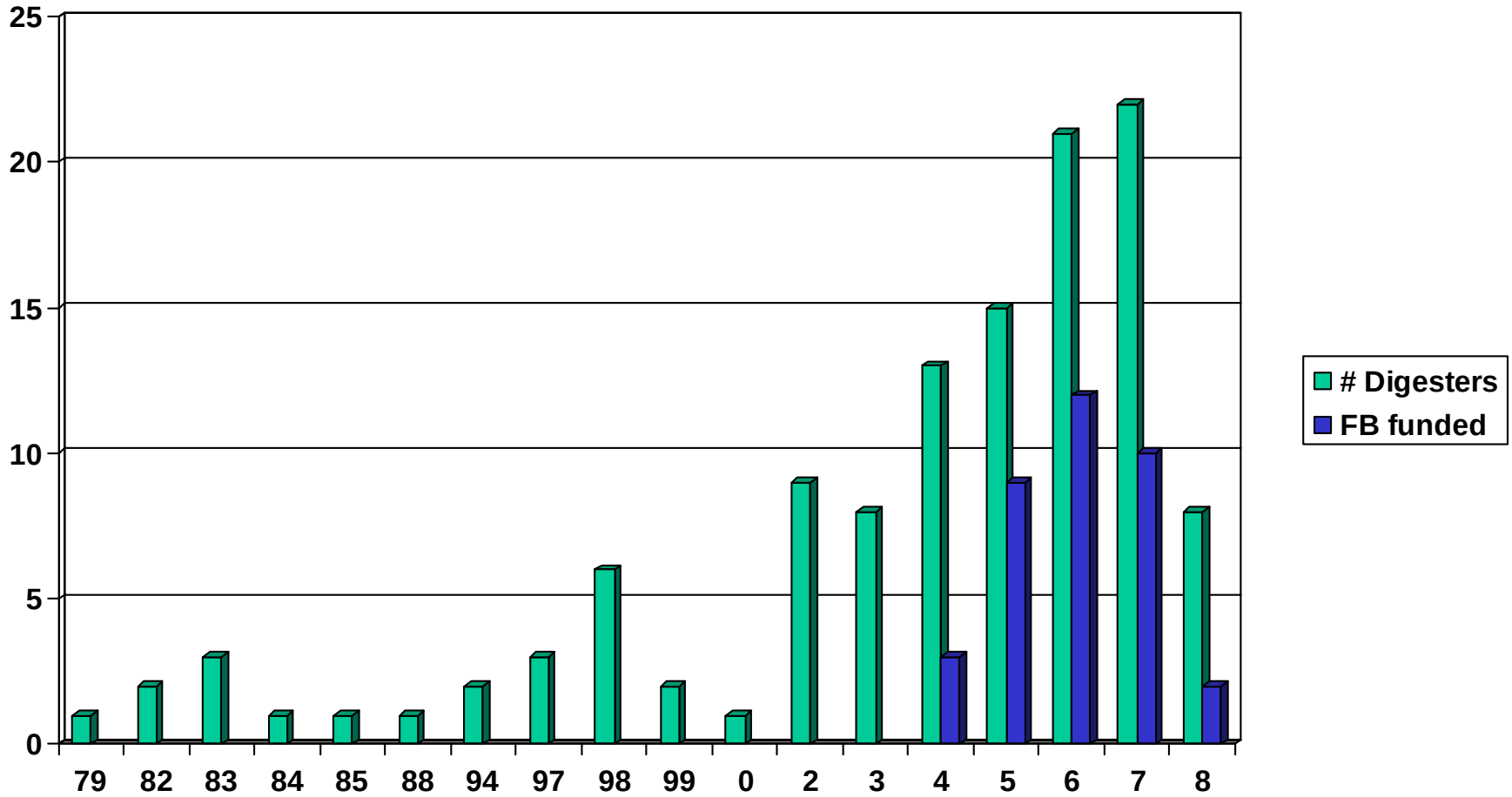
- Currently ~120 anaerobic digesters for manure
  - 95 – dairy cattle
  - 2 – beef cattle
  - 15 – pigs
  - 8 – poultry (chicken, ducks)
- Sizes
  - Small – 200 dairy cattle
  - Medium – 3000 pigs/2,000 dairy
  - Large – 10,000 dairy cattle
- Climate
  - Both cold and warm climates
  - Both wet and dry areas

2008 Operating Manure Digesters



Number of Operating Projects / Estimated Energy Production (MWh/yr equivalent)
Total Operating Projects: 120
Total Estimated Energy Production: 253,933 MWh/yr equivalent

Number of Digesters Becoming Operational Per Year (1979-2008)



2008 Farm Bill and USDA

- Farm Bill 2008 a major project driver
  - **Rural Energy for America Program (REAP)** offers new opportunities for technical assistance, training and feasibility studies
    - In 2008 awarded ~$34 M in grants awarded for 769 projects and ~$15 M in loan guarantees
  - State agencies and NGOs can now access funding
- NRCS awarding more dollars to ADs through Conservation Innovation Grants (CIG)
- ARS looking at ADs as research priority

Vision for AD Industry

- Create a multi-billion dollar industry based on methane capture and use at livestock operations
  - Enable innovative business models that create equity for farmers and rural communities and advance their energy independence
  - Secure markets for energy, nutrients, value-added products, and carbon
  - Establish an environment that favors project establishment
  - Facilitate next generation technologies that advance superior environmental performance
- ** Reap the environmental and energy benefits

Economy-wide Impacts

- Potential billions into the economy for installing digester and energy generation systems alone
- Added revenue/value for:
  - Energy sales and on farm savings
  - Carbon credits
    - estimated 27 million tons CO_2 equivalent (1.3 million tons methane) annually could be reduced
  - Tipping fees
  - Animal-processed fibers (bedding, etc.)
  - Nutrient sales
- Indirect impacts
  - As local wealth grows, so grows the economy (hamburgers, clothes, movies, etc.)

Major Project Drivers – 2008

- More project developers joining the industry:
  - New business models may require less up-front cost and risk to farmers
  - Energy generation more critical
  - Carbon and renewable energy credits growing
  - Most new entrants are business and energy savvy
- Increase in 3rd party investment
- Emergence of European designs in U.S. market (especially dairy)
- Market developing for dairy manure fibers (up to 60% of project revenue)
  - Bedding
  - Potting soil (peat moss replacement)
  - Fiber boards
- Continuing - AD systems help reduce odors, comply with environmental regulations, nutrient management plans, and increase farm productivity/economics.

Mainstream Media

4B · FRIDAY, FEBRUARY 9, 2007 · USA TODAY

Biomass plants find power in poop

Alternative energy sources surge toward comeback

By Paul Davidson
USA TODAY

Here's the stuff of America's energy future: wood trimmings, cow manure, chicken litter, household trash and landfill gas.

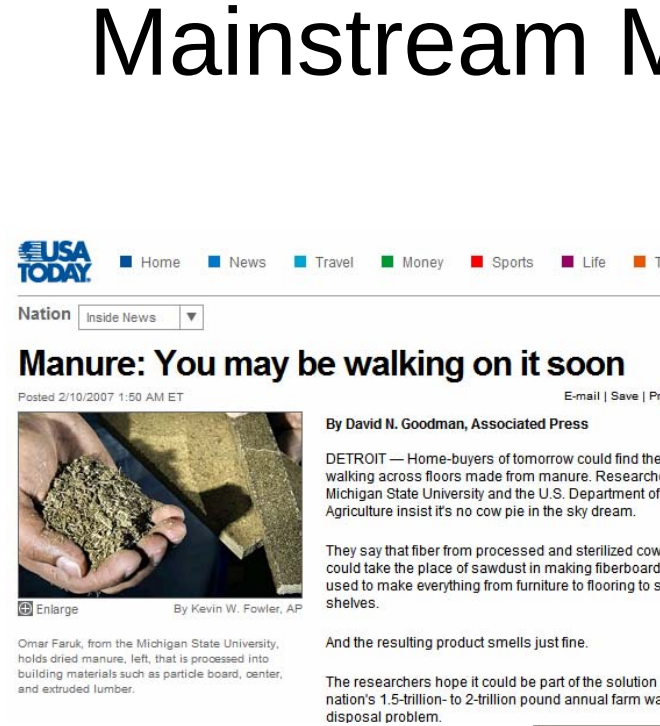
Debris is becoming a hot commodity in some areas as the U.S. power industry seeks to lessen its dependence on fossil fuels amid growing global-warming concerns.

With renewable energy, taking off, wind and solar power are hogging the limelight, but biomass-fired electricity is quietly making a comeback after a decade-long slump. Biomass is animal and plant wastes used as a fuel source.

In his State of the Union address, President Bush cited the need for biomass as a gasoline substitute. Now 80% of biomass is now used for electricity and heat, says the Center for Renewable Energy.

Biomass plants burn the organic refuse to produce steam that turns generators. They already represent 1% of U.S. electricity capacity and

Bark power: Bill Leopolis, chief forester for the Burlington Electric Department, walks through the McNeil Plant in Burlington, Vt. Below, driver Dennis Barbian empties his truck of 35 tons of bark at the Burlington plant. The load of bark can power the plant for 25 minutes.



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Manure: You may be walking on it soon

Posted 2/10/2007 1:50 AM ET

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Enlarge By Kevin W. Fowler, AP

Omar Faruk, from the Michigan State University, holds dried manure, left, that is processed into building materials such as particle board, center, and extruded lumber.

By David N. Goodman, Associated Press

DETROIT — Home-buyers of tomorrow could find the walking across floors made from manure. Research Michigan State University and the U.S. Department of Agriculture insist it's no cow pie in the sky dream.

They say that fiber from processed and sterilized cow could take the place of sawdust in making fiberboard used to make everything from furniture to flooring to s shelves.

And the resulting product smells just fine.

The researchers hope it could be part of the solution to the nation's 1.5-trillion- to 2-trillion pound annual farm waste disposal problem.

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Compost and Manure

Gardening by the Yard : Episode GBY-106 -- More Projects »

Compost is an excellent source to enrich the soil, and if it is applied on a regular basis, the amount of fertilizer can be reduced to about half.

Manure, which contains nitrogen and other precious materials, is used as a source of raw material for compost piles. It can be put around trees, shrubs, flowers and vegetable gardens. It can also be used as a top dressing for the lawn. There are a number of packaged manure products on the market: The Real Poop, Zoo Doo, Bat Guano, Earth Worm Castings and Cricket Krap.

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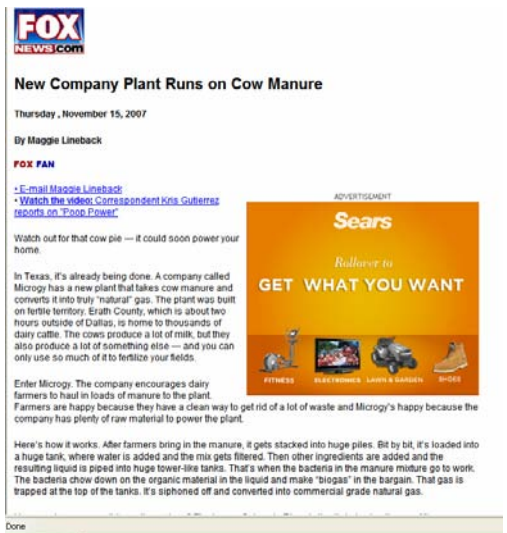

FOX NEWS.com

New Company Plant Runs on Cow Manure

Thursday , November 15, 2007

By Maggie Lineback

FOX FAN

• E-mail Maggie Lineback
• Watch the video: Correspondent Kris Gutierrez reports on "Poop Power"

Watch out for that cow pie — it could soon power your home.

In Texas, it's already being done. A company called Microgy has a new plant that takes cow manure and converts it into truly "natural" gas. The plant was built on fertile territory. Erath County, which is about two hours outside of Dallas, is home to thousands of dairy cattle. The cows produce a lot of milk, but they also produce a lot of something else — and you can only use so much of it to fertilize your fields.

Enter Microgy. The company encourages dairy farmers to haul in loads of manure to the plant. Farmers are happy because they have a clean way to get rid of a lot of waste and Microgy's happy because the company has plenty of raw material to power the plant.

Here's how it works. After farmers bring in the manure, it gets stacked into huge piles. Bit by bit, it's loaded into a huge tank, where water is added and the mix gets filtered. Then other ingredients are added and the resulting liquid is piped into huge tower-like tanks. That's when the bacteria in the manure mixture go to work. The bacteria chow down on the organic material in the liquid and make "biogas" in the bargain. That gas is trapped at the top of the tanks. It's siphoned off and converted into commercial grade natural gas.

Done

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News Front Page > Environment

New Ethanol Plants to Be Fueled by Cow Manure

Scott Norris
for National Geographic News
August 10, 2006

While a cheap alternative to gasoline may be pie in the sky, ethanol producers in cattle country will soon be reaping the energy rewards of pies on the ground.

Ethanol production plants fueled by cow manure are under construction in Hereford, Texas, and Mead, Nebraska.

Enlarge Photo

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RELATED

Ethanol Plant "Brews" Grass into

The new facilities may have a big impact on the growing debate over the value of ethanol—a liquid fuel distilled from food starches such as corn—as a supplement or alternative to gasoline.

Critics have long argued that traditional ethanol production consumes nearly as much fossil fuel energy as it saves, once all the energy costs of growing and processing corn are factored in.

(Read "Ethanol Not So Green After All?" [July 2006].)

But in Hereford, a cattle town in the Texas Panhandle (Texas map), Dallas-based Panda Ethanol is building a production facility driven by the area's most abundant and least appreciated resource: manure.

The new plant is expected to extract methane from 1 billion pounds (453,000 metric tons) of manure—the product of

Done

Analysis from FORTUNE: Plugged In

Column archive

The scoop on poop

Entrepreneurs say waste need not be wasted.

By Marc Gunther, FORTUNE senior writer
June 21, 2006: 5:12 PM EDT

NEW YORK (FORTUNE) - This is a column about poop: cow manure that can be turned into electricity, "green" baby diapers that can be put in the toilet and waterless urinals that don't flush.

Hold your nose if you must, but it turns out that there's money to be made in finding ways to dispose of waste in ways that are cleaner and better for the planet.

A company called Environmental Power Corp., with headquarters in Portsmouth, New Hampshire, operates three methane digesters in Wisconsin that process cow manure into natural gas, which can then be converted to electricity. The company is developing poop-to-power projects in Texas and California, too.

Then there's a startup called gDiapers, which sells a "diaper system" with an inner layer that can be safely flushed down the toilet, thereby keeping disposable diapers out of landfills - where 18 to 20 billion are

Project Types

- Single-Farm Digester:
  - Biogas from single producer
  - Ownership and/or operation could be producer or third party
- Multi-Farm Digesters (Regional or Centralized):
  - Biogas of multiple producers
    - Moving manure very expensive; moving biogas by pipeline may be better option
  - Could reside at a farm or other location
  - Preferably near large energy user or utility interconnection point

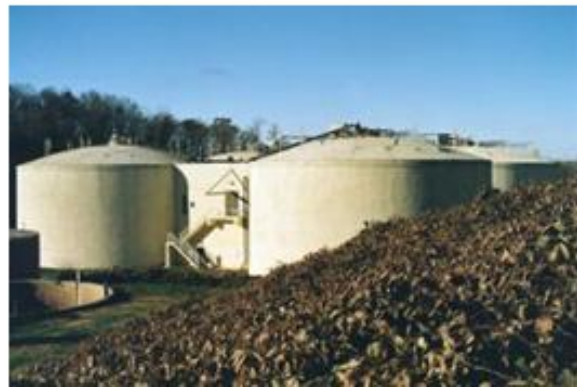
- Both could include other organic waste feed stocks
  - Cheese whey, ice cream, brewery, winery, greases/oils.

Heated Plug Flow Digesters

(usually for dairy manure)

Heated Mixed Digesters

Multi-Farm Digesters



Biogas Uses

- Direct Use – offset use of natural gas
  - Boilers – hot water
  - Heaters – infrared heaters for space heating
  - Greenhouse
  - Industry (lumber, food processing, food storage, brick, steel, cement)
- Pipeline Upgrade
- Combined Heat and Power
- Electricity

Gas Use: Flares

Odor Control and Greenhouse Gas Mitigation (and backup)

Gas Use: Electrical Generation

Recip. Engines 40-250kW

COMPONENTS

Gas Handling

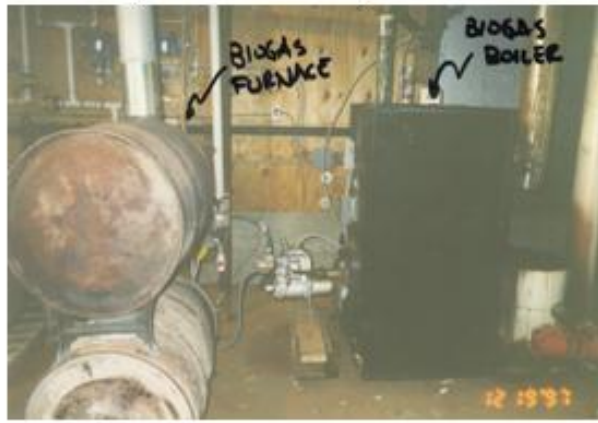
Engine Controller

Electric Metering

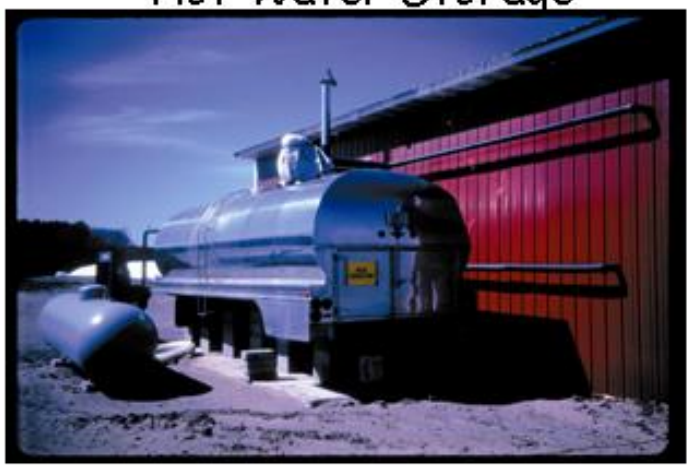
Gas Use: Heat

Boilers

Forced Air



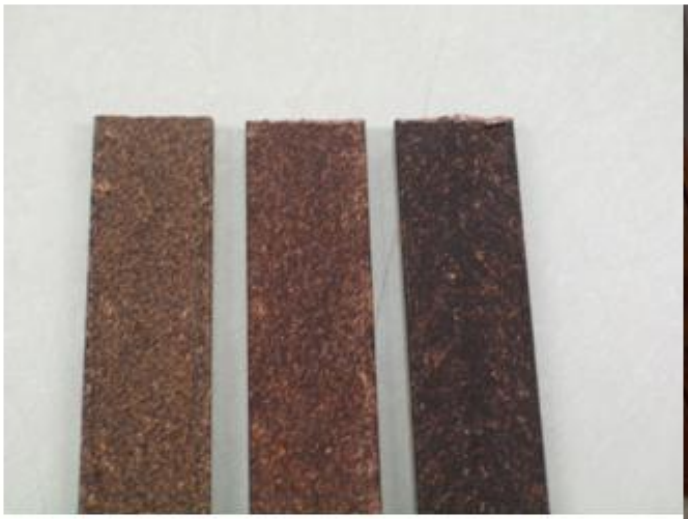
Hot Water Storage



Hot Water Use

Value Added Products

Dairy Manure Fibers



Fiberboard/Decking

Building Materials

Horticulture – soil/peat replacement

Cow Pots

Innovation

Participants/Program

- Local, state, tribal and federal levels; private companies; universities; utilities and energy providers; non-profits; dairymen
- Project developer panel
  - Modified plug flow, complete mix tank, covered lagoon, carbon credits, animal processed fibers (manure solids), co-digestion, gas upgrade
- Money/Economics
- Nutrients

- Tour

Questions

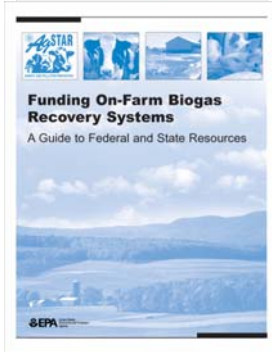
- Who's considered a digester project?
  - Why haven't you done it yet?
  - What do you think your main goals are for a project are?
- Who has permitted a digester
  - Major issue at hand?
- Who has done research on digesters?
  - Main hurdle to widespread adoption?
- Who's seen a digester project in person?

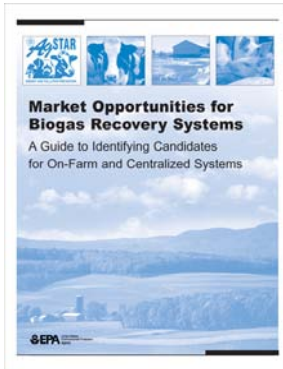
USEPA AgSTAR Program

- Began in 1993
- Provides technical assistance to livestock producers in dairy, swine and poultry industries.
- Advance the concept of manure anaerobic digesters for greenhouse gas control and environmental improvement.

AgSTAR Resources

- General Outreach
  - Annual AgSTAR Conference, AgSTAR Digest newsletter, Farm Extension Events, Workshops
- Project Development
  - *Managing Manure with Biogas Recovery Systems*
  - *Industry Directory*
  - *Funding Guide for Federal and State Resources*
  - *Market Opportunities for Biogas Recovery Systems*
- Technical Analysis
  - A Protocol for Quantifying and Reporting the Performance of Anaerobic Digestion Systems for Livestock Manures
  - Mass Balance Waste Management Evaluations
  - Dairy and Pig Manure Case Studies
- Project Evaluation Tools
  - AgSTAR Handbook - A Manual for Developing Biogas Systems at Commercial Farms in the United States
  - FarmWare - develops project specific feasibility assessments
- Website - www.epa.gov/agstar
- Contact
  - Chris Voell, voell.christopher@epa.gov, 202-343-9406





Gordondale Designs for the Future

Location	Nelsonville, Wisconsin
Project Type	Farm scale
Animal Type	Dairy
Population	860 head milking herd
Baseline System	Storage pit
Digester Type	Horizontal plug flow with vertical gas mixing
System Designer	GHD, Inc.
Biogas Use	Cogeneration
Generating Capacity	135 kW Caterpillar 3406
Receiving Utility	Alliant Energy

Farm Bill Funded Project

USDA Rural Development
Committed to the future of rural communities.

Since April 2002, Gordondale Farms has successfully operated an innovative anaerobic digester that offers multiple benefits. The owners took advantage of the opportunity to install the digester during a planned farm expansion in 2001. Gordondale chose the design for its many economic and environmental benefits, plus the flexibility to grow with the farm.

Photo: Alliant Energy

The 71,000 ft^3 digester employs a fixed cover and a U-shaped channel. The U-shape was chosen because locating the influent and effluent equipment next to each other made sense for the project. Plus, the digester can easily be expanded by extending the looped end. A patented biogas injection system mixes the slurry vertically to enhance digestion and the fixed cover virtually eliminates odors.

After digestion, a screw press separator mechanically separates coarse fibrous solids from the digester effluent, which is used for bedding with excess sold to other farms. This system allows for improved nutrient management planning, better water quality protection, and the system generates revenue.

Alliant Energy owns and maintains the electricity-generating equipment and pays a set fee per kWhr. All of the electricity generated is delivered to Alliant's tran
Gordondale purchases electricity from Alliant.

Documents, Tools and Resources

AgSTAR Funding Guide

The AgSTAR Funding Database provides a list of state, federal, and private funding opportunities for anaerobic digestion projects. These opportunities include programs that provide incentives such as low interest loans, loan guarantees, grants, and tax incentives. Before pursuing funding opportunities, AgSTAR recommends that applicants discuss their ideas with the funding agency to ensure that the program is appropriate for the project and its goals.

State Renewable Portfolio Standards (RPS) create a demand for renewable energy to help remove market barriers. For more information on state RPS programs that include biogas as eligible resources please visit our RPS page.

This AgSTAR Funding Database is a dynamic list that will be updated and expanded periodically. If you know of an option or resource that should be added, or if you have suggestions about how to make this document more useful, please e-mail agstar@erg.com.

Search by state or region: Select One

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Incentive Name	Type of Incentive	Eligible Organizations	State
Advancing Colorado's Renewable Energy Program	Loan, Grant	Livestock Producer, Commercial/Industrial Business, Small Business, Local Government	CO
Agriculture Energy Efficiency Program	Grant	Educational Institution, Local Government, Nonprofit, State Government	AL
Alternative Energy Revolving Loan Program	Loan	Educational Institution, Local Government, Nonprofit, Residential, Small Business	MT
Alternative Energy Revolving Loan Program	Loan	Livestock Producer, Commercial/Industrial Business, Residential, Small Business	IA
Anaerobic Digester Gas-to-Electricity Program	Grant, Production Incentive	Livestock Producer	NY
Animal Waste Treatment Loan Program	Loan	Livestock Producer	MO
Arizona Public Service - Renewable Incentive Program	Production Incentive	Livestock Producer, Commercial/Industrial Business	AZ

Methane to Markets Partnership

- Began in 2004
- Encourages development of ***cost-effective*** methane recovery and use opportunities in
  - coal mines
  - landfills
  - oil and gas systems and
  - **livestock manure & food processing wastes**
- Private companies, multilateral development banks and other relevant organizations participate by joining the
  - *Project Network – over 650 organizations now participating*
- Over 25 Partner Governments

Argentina
Australia
Brazil
Canada
Colombia
China
European Comm.
Ecuador
Germany
India
Italy
Japan
Korea
Mexico
Mongolia
Nigeria
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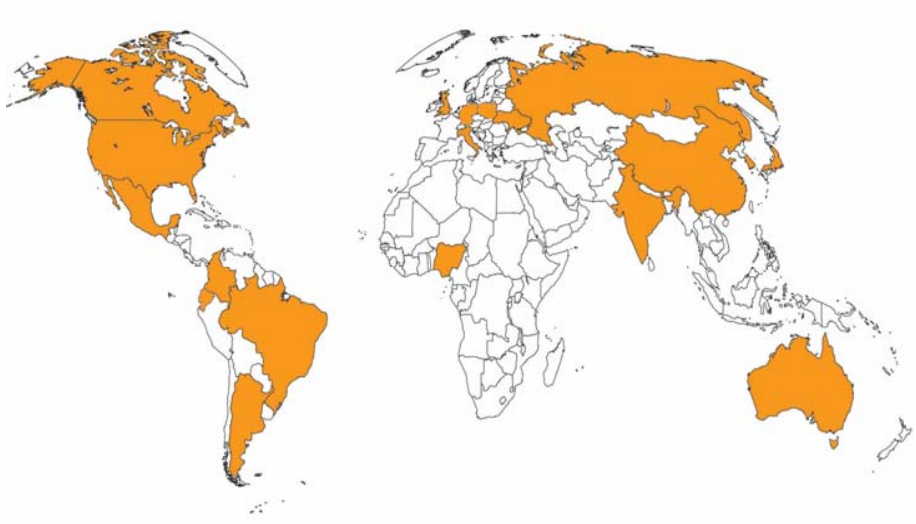
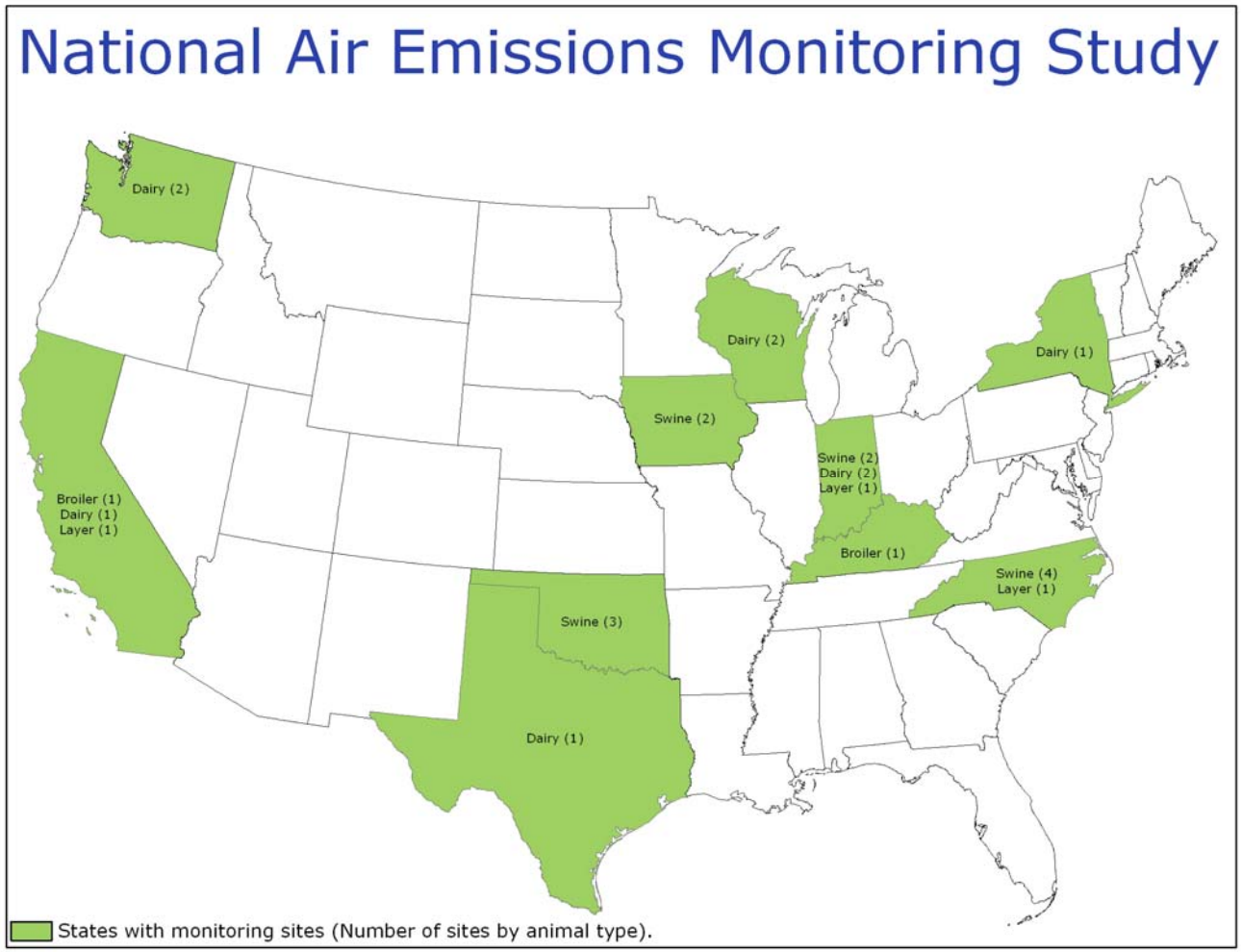
Philippines
Poland
Russia
Thailand
**Ukraine
United Kingdom
United States
Vietnam



Element 5: Regulatory Program

Air: OAQPS and OECA



AgSTAR National Conference 2009

February 24-25, 2009
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Convention Center
Baltimore, Maryland

- Technical Sessions
- Networking
- Social Events

Remember…...

- Solar energy when the sun shines,
- Wind energy when the wind blows,

But manure doesn’t stop.

Biogas energy all the time!

For more information…

www.epa.gov/agstar

www.methanetomarkets.org

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